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Correlation Between Helicobacter Pylori Infection and Iron Deficiency Anemia in School-Aged Children

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ABSTRACT

Background: Iron deficiency anemia (IDA) is recognized as a common nutritional problem in infants and young children in developing countries mainly due to poor nutrition in most cases.

Objective: To evaluate the association between H. pylori infection and iron deficiency anemia in school-aged children.

Patients and Methods: This study was conducted on 60 participants divided into two groups. Group I: formed of 30 patients suffering from iron deficiency anemia with hemoglobin (Hb) less than l1g/dL. Group II: formed of 30 healthy children (control Group)

Results: In the current study we found that there was a significant decrease in weight and BMI among cases group p-value <0.001. In the current study, we found that there was a significant decrease in all CBC parameters among cases versus control. In the current study we found that there were significant differences between the two groups regarding nutritional status as in cases there was a higher percentage of low iron sources in the diet, there was a significant decrease in serum iron, ferritin, and TIBC in cases versus control. In the current study, we found that there was a significant increase in the number of positive samples for H pylori antigen in stool among cases versus control 63.3% versus 23.3% p-value 0.002.

Conclusion: The results of this study demonstrate a significant association between children with iron deficiency anemia and positive H. pylori infection in school-age children. Moreover, H. pylori infection may be one of the significant causes of iron deficiency anemia.

Keywords: Iron deficiency anemia, Helicobacter Pylori**,** School-aged children**.**

INTRODUCTION

Iron deficiency (ID), the most common nutritional disorder among infants and young children particularly in developing countries [1, 2].

Iron deficiency anemia (IDA) is defined as hemoglobin below the 5th percentile of normal for the age that is caused by the lack of iron. Most studies showed that cut off point to be around (-2 SD below the mean) [2].

Based on the WHO estimation, iron deficiency is responsible for 50 percent of all types of anemia. The prevalence of IDA during infancy and early childhood is high because of high iron requirements in this age group, dietary iron bioavailability, and gastrointestinal infections which are frequent in developing countries [2].

Helicobacter pylori (H. pylori) infection is one of the most common bacterial infections in developing countries which usually affects children and if not treated, usually continues to exist in the body for a long time. This bacterium can cause gastrointestinal disorders such as chronic active gastritis, stomach cancer, and peptic ulcer [3].

The high prevalence of combined H. pylori infection and IDA in developing countries suggests that infection with this bacterium may be a cause of IDA. Possible mechanisms include increased iron uptake by the H. pylori bacterium and blood loss due to gastric lesions as a consequence of H. pylori infection [4]. Reduced iron absorption due to an elevated pH of the gastric juice has also been attributed to H. pylori [5].

As H. Pylori infection is primarily acquired in childhood, and iron stores are lower in children than in adults, children are thought to be at particularly increased risk for iron deficiency[6].

AIM OF THE WORK

Correlate between H. pylori infection and iron deficiency anemia in school-aged children.

PATIENTS AND METHODS

The present study was carried out in the pediatric clinic and pediatric department in Sohag general hospital in the period from March to December 2018.

The present study was carried out on 60 participants divided into two groups:

Group I: Formed of 30 patients diagnosed as iron deficiency anemia with hemoglobin (Hb) less than l1g/dL according to WHO description [2]. They were 21 males and 9 females, and their age ranged between 4-10 years.

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Group II: Formed of 30 apparently healthy children (control group). They were 19 males and 11 females (their ages ranged between 5-11 years).

Ethical Consideration:

To start this study, a formed written consent was obtained from the child's parents and the nature and the aim of our study were explained to them.

The study approved from the ethical consideration committee of Al-Azhar University.

All children who were diagnosed as IDA had H. pylori stool Ag positive or both have received their treatment by us and were followed up by laboratory investigations until complete recovery.

Inclusion criteria: Children ages: all children from both sexes had their ages ranged from (5-10) years. Children diagnosed with iron deficiency anemia with Hb less than 11g/d according to WHO description [(2)].

Exclusion criteria: Children with other types of anemias. Children with chronic illnesses e.g. (CRF, CHF, chronic hemolytic anemias, etc.). Children on iron supplementation. Children with parasitic infections. Non-age matched children.

Methodology:

Complete blood picture: A complete hemogram was estimated using automated hematology Beckman Coulter Counter, USA (Hb, Ht, RBC count, MCV, MCHC, WBC count): after taking 1.5cm blood from a peripheral vein under the aseptic condition on test tube containing EDTA [(7)].

Biochemical serum markers of IDA: Venous blood was obtained from the children (2cm) under aseptic conditions. All blood samples were dispensed into dry glass test tubes for clotting and retraction to take place. Sera were obtained after samples were centrifuged at 2000 g for five minutes and stored at -20°C until assayed for laboratory investigations.

Quantitative determination of serum iron: Serum iron concentration were investigated by direct enzymatic method; after dissociation of iron-transferring bound in acid medium, ascorbic acid reduces Fe+3 iron into Fe+2 iron. The absorbance measured at 600 nm is directly proportional to the amount of iron in the specimen. The normal range of iron in children is 50-120 ug/ml [(8)].

Quantitative determination of serum ferritin: Ferritin was detected by ELISA; this assay system utilizes one rabbit anti-ferritin antibody for solid-phase immobilization and a mouse monoclonal anti-ferritin antibody in the antibody-enzyme (horseradish peroxidase) conjugate solution. The normal range of ferritin in children is 7-120ng/ml [(8)].

Ferritin is a very good marker for iron deficiency but since ferritin is an acute-phase protein, it can be elevated in inflammation conditions that normal serum ferritin may not always exclude iron deficiency, so iron is measured too as another indicator for iron deficiency [(8)].

Total iron-binding capacity: TIBC (umol/L) =25.1×TRF (g/l) [(9)] was measured after saturation of the transferrin by an iron solution and adsorption of the excess iron-on magnesium hydroxycarbonate. The determination of iron bound to transferrin was then performed using the complimentary kit on Hitachi 912 auto analyzer.

Helicobacter pylori stool Antigen: Fecal antigen test is the preferable strategy for diagnosis of H. pylori in primary care; as the fecal antigen test is the most effective in terms of true outcomes and cost [(10)].

Test principle:

The Rapid-VIDITEST H. pylori Card is a qualitative immune chromatographic assay for the determination of Helicobacter pylori in fecal samples. The membrane is pre-coated with monoclonal antibodies, on the test band region, against H. pylori antigens. During testing, the sample can react with the colored conjugate (anti-H. pylori monoclonal antibodies-red polystyrene microspheres) which was pre-dried on the test strip. The mixture then moves upward on the membrane by capillary action.

As the sample flows through the test membrane, the colored particles migrate. In the case of a positive result, the specific antibodies present on the membrane will capture the colored conjugate. The mixture continues to move across the membrane to the immobilized antibody placed in the control band region, a red-colored band always appears. The presence of this red band serves as Verification that enough volume is added. That proper flow is obtained. As an internal control for the reagents.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc, Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Independent-samples t-test of significance was used when comparing two means. Chi-square (x^2) test of significance was used to compare proportions between two qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following: P-value <0.05 was considered significant. P-value <0.001 was considered highly significant. P-value >0.05 was considered insignificant.

RESULTS

Table (1): Comparison between the two studied groups according to demographic data

	Cases (n = 30)		Control (n = 30)		Test of Sig.	P-value
	No.	%	No.	%		
Gender						
Male	21	70.0	11	36.7	χ^2= 6.696 *	0.010*
Female	9	30.0	19	63.3		
Age (years)						
Min. – Max.	4.90–10.50		5.10–10.80		t= 0.529	0.599
Mean ± SD.	7.59± 2.0		7.86±1.86			
Median (IQR)	7.05 (5.6–9.8)		7.55 (6.3–9.9)			
Residence						
Urban	7	23.3	9	30.0	χ^2= 0.341	0.559
Rural	23	76.7	21	70.0		
Socio-economic State						
Moderate	14	46.7	24	80.0	χ^2= 7.177*	0.007*
Low	16	53.3	6	20.0		
Birth Order						
Min. – Max.	1.0 – 4.0		1.0 – 5.0		U= 392.0	0.369
Mean ± SD.	2.20 ± 0.92		2.03 ± 1.13			
Median (IQR)	2.0 (1.0 – 3.0)		2.0 (1.0 – 3.0)			
Consanguinity						
No	20	66.7	19	63.3	χ^2= 0.073	0.787
Yes	10	33.3	11	36.7		

χ2: Chi-square test **t: Student t-test** **U: Mann Whitney test**

p: p-value for comparing between the studied groups *: Statistically significant at $p \leq 0.05$

This table shows that there were insignificant differences between the two groups regarding demographic data except in gender and socioeconomic status there was male predominance and low socioeconomic status among the patients' group.

Table (2): Comparison between the two studied groups according to CBC

CBC	Cases (n = 30)	Control (n = 30)	Test of Sig.	p-value
Hb				
Min. – Max.	8.60–10.70	11.50–13.10	t= 18.103*	<0.001*
Mean ± SD.	10.0 ± 0.51	12.32± 0.48		
Median (IQR)	10.10 (9.70 – 10.30)	12.30 (11.90 – 12.80)		
Hct				
Min. – Max.	24.30–27.60	30.40–40.20	t= 19.031*	<0.001*
Mean ± SD.	26.43± 0.92	35.90±2.57		
Median (IQR)	26.50 (25.90 – 27.30)	36.05 (34.20 – 37.70)		
MCV				
Min. – Max.	59.70–65.60	64.70–81.20	t= 7.524*	<0.001*
Mean ± SD.	63.40±1.58	71.49±5.68		
Median (IQR)	63.60 (62.10 – 64.90)	69.60 (66.60 – 78.10)		
MCH				
Min. – Max.	22.10–33.40	25.20– 32.0	U= 31.0*	<0.001*
Mean ± SD.	24.21 ± 1.90	28.08 ± 2.02		
Median (IQR)	24.05 (23.40–24.50)	27.65 (26.30–29.10)		
MCHC				
Min. – Max.	34.10–37.70	34.90–38.80	t= 3.368*	0.001*
Mean ± SD.	36.07±1.10	37.05±1.15		
Median (IQR)	36.30 (35.40 – 36.70)	37.25 (36.20 – 38.10)		
RBCs				
Min. – Max.	3.80–4.80	4.30–5.60	t= 9.077*	<0.001*
Mean ± SD.	4.23± 0.22	4.94± 0.37		
Median (IQR)	4.20 (4.10 – 4.30)	4.90 (4.70 – 5.20)		
WBCs				
Min. – Max.	6.40–10.60	5.80–8.20	t= 3.869*	<0.001*
Mean ± SD.	7.85±1.02	7.0 ± 0.64		
Median (IQR)	7.65 (7.30 – 8.40)	7.10 (6.50 – 7.30)		

t: Student t-test **U: Mann Whitney test**

p: p-value for comparing between the studied groups

*: Statistically significant at $p \leq 0.05$

This table shows that there was a significant decrease in all CBC parameters among cases versus controls.

Table (3): Comparison between the two studied groups according to iron profile

Iron profile	Cases (n = 30)	Control (n = 30)	Test of Sig.	p-value
Serum iron (µg/dL)				
Mean ± SD.	51.57±7.71	79.17±13.24	t= 6.173*	
Median (IQR)	51.0 (47.0 – 57.0)	80.50 (56.0 – 93.0)		
Serum ferritin (ng/mL)				
Mean ± SD.	25.29 ± 5.59	48.55 ± 7.39	U= 104.0*	
Median (IQR)	18.0 (16.3 –27.0)	50.55 (42.1 – 53.2)		
TIBC (µg/dL)				
Mean ± SD.	389.13 ± 26.90	339.0 ± 34.05	t= 6.327*	
Median (IQR)	390.0 (376.0 – 407.0)	337.5 (313.0 – 369.0)		

t: Student t-test **U: Mann Whitney test**

p: p-value for comparing between the studied groups. *: Statistically significant at $p \leq 0.05$

This table shows that there was a significant decrease in serum iron, ferritin, and TIBC in cases versus control.

Table (4): Comparison between the two studied groups according to H. pylori antigen in stool

H.Pylori Antigen in Stool	Cases (n = 30)		Control (n = 30)		χ^2	p-value
	No.	%	No.	%		
Negative	11	36.7	23	76.7	9.774*	0.002*
Positive	19	63.3	7	23.3		

χ^2: **Chi-square test**
p: p-value for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$.

This table shows that there was a significant increase in the number of positive samples for Pylori antigen in stool among cases versus control 63.3% versus 23.3% p-value 0.002.

Table (5): Relation between the H.pylori antigen in stool and demographic data in cases group (n= 30)

	H.pylori antigen in stool				Test of Sig.	p-value
	Negative (n = 11)		Positive (n = 19)			
	No.	%	No.	%		
Sex						
Male	7	63.6	14	73.7	χ^2= 0.335	0.687
Female	4	36.4	5	26.3		
Age (years)						
Min. – Max.	5.10 – 10.30		4.90 – 10.50		t= 0.079	0.937
Mean ± SD.	7.55 ± 1.93		7.62 ± 2.10			
Median	6.90		7.20			
Residence						
Urban	2	18.2	5	26.3	χ^2= 0.258	1.000
Rural	9	81.8	14	73.7		
Socio-economic State						
Moderate	4	36.4	10	52.6	χ^2= 0.741	0.389
Low	7	63.6	9	47.4		
Birth Order						
Min. – Max.	1.0 – 4.0		1.0 – 4.0		U= 91.500	0.557
Mean ± SD.	2.09 ± 0.94		2.26 ± 0.93			
Median	2.0		2.0			
Consanguinity						
No	8	72.7	12	63.2	χ^2= 0.287	0.702
Yes	3	27.3	7	36.8		

χ2: Chi-square test **t: Student t-test** **U: Mann Whitney test**
p: p-value for the association between H. pylori antigen in stool and demographic data

Table (6): Relation between the H. pylori antigen in stool and nutritional state

Nutritional State	H.pylori antigen in stool				χ^2	p-value
	Negative (n = 11)		Positive (n = 19)			
	No.	%	No.	%		
Junk foods	5	45.5	5	26.3	1.675	0.510
Balanced diet	0	0.0	2	10.5		
Low iron sources in diet	6	54.5	12	63.2		

χ^2: **Chi-square test**
p: p-value for the association between H.pylori antigen in stool and nutritional state

Table (7): Relation between the H.pylori antigen in stool and complaint

Complaint	H.pylori antigen in stool				χ^2	p-value
	Negative (n = 11)		Positive (n = 19)			
	No.	%	No.	%		
Recurrent Abd. Pain	7	63.6	8	42.1	1.292	0.256
Poor Appetite	4	36.4	11	57.9	1.292	0.256
Easy Fatiguability	6	54.5	12	63.2	0.215	0.712
Poor Concentration	5	45.5	11	57.9	0.433	0.510
No Complaint	0	0.0	3	15.8	1.930	0.279
Pallor	11	100.0	13	68.4	4.342	0.061

χ^2: **Chi-square test**
p: p-value for association between H.pylori antigen in stool and complaint

Table (8): Relation between the H.pylori antigen in stool and measure data

	H.pylori antigen in stool		t	p-value
	Negative (n = 11)	Positive (n = 19)		
Weight (kg)				
Min. – Max.	17.10 – 29.20	17.20 – 30.0		
Mean ± SD.	21.53 ± 3.68	22.63 ± 4.27	0.713	0.482
Median	21.30	22.70		
Height (cm)				
Min. – Max.	106.0 – 136.0	107.0 – 140.0		
Mean ± SD.	121.09 ± 10.77	122.11 ± 10.99	0.245	0.808
Median	120.0	122.0		
BMI (kg/cm^2)				
Min. – Max.	13.30 – 15.80	12.60 – 17.60		
Mean ± SD.	14.68 ± 0.89	15.15 ± 1.15	1.170	0.252
Median	14.70	15.30		

t: Student t-test
p: p-value for the association between H.pylori antigen in stool and measure data

Table (9): Relation between the H.pylori antigen in stool and CBC

CBC	H.pylori antigen in stool		Test of Sig.	p-value
	Negative (n = 11)	Positive (n = 19)		
Hb				
Min. – Max.	9.30 – 10.70	8.60 – 10.70	t= 2.387*	0.024*
Mean ± SD.	10.27 ± 0.37	9.84 ± 0.53		
Median	10.30	9.90		
Hct				
Min. – Max.	24.30 – 27.40	24.70 – 27.60	t= 1.559	0.130
Mean ± SD.	26.09 ± 1.07	26.62 ± 0.78		
Median	26.10	26.70		
MCV				
Min. – Max.	62.10 – 65.30	59.70 – 65.60	t= 1.807	0.081
Mean ± SD.	64.05 ± 1.13	63.02 ± 1.70		
Median	64.10	62.80		
MCH				
Min. – Max.	23.10 – 25.50	22.10 – 33.40	U= 79.5	0.281
Mean ± SD.	24.24 ± 0.72	24.19 ± 2.35		
Median	24.30	23.70		
MCHC				
Min. – Max.	34.50 – 37.70	34.10 – 37.70	t= 1.249	0.222
Mean ± SD.	36.40 ± 0.94	35.88 ± 1.17		
Median	36.50	36.30		
RBCs				
Min. – Max.	4.10 – 4.60	3.80 – 4.80	t= 1.673	0.106
Mean ± SD.	4.32 ± 0.20	4.18 ± 0.22		
Median	4.30	4.20		
WBCs				
Min. – Max.	6.40 – 10.60	6.50 – 10.10	t= 0.178	0.860
Mean ± SD.	7.89 ± 1.26	7.82 ± 0.89		
Median	7.80	7.60		

t: Student t-test **U: Mann Whitney test**

p: p-value for the association between H.pylori antigen in stool and CBC

*: Statistically significant at $p \leq 0.05$

Table (10): Relation between the H.pylori antigen in stool and iron profile

Iron profile	H pylori antigen in stool		Test of Sig.	p-value
	Negative (n = 11)	Positive (n = 19)		
Serum iron (µg/dL)				
Mean ± SD.	53.09 ± 7.58	50.68 ± 7.85	t= 0.819	0.420
Median	53.0	50.0		
Serum ferritin (ng/mL)				
Mean ± SD.	29.84 ± 17.80	22.66 ± 3.98	U= 63.0	0.074
Median	20.30	17.0		
TIBC (µg/dL)				
Mean ± SD.	375.09 ± 31.68	397.26 ± 20.44	t= 2.337*	0.027*
Median	381.0	401.0		

t: Student t-test **U: Mann Whitney test**

p: p-value for the association between H pylori antigen in stool and iron profile,

*: Statistically significant at $p \leq 0.05$

DISCUSSION

This study was conducted on 60 participants divided into two groups with insignificant differences between two groups as regards demographic data except in gender and socioeconomic status there was male predominance and low socioeconomic status among patients' group.

Abou-Taleb *et al.* [11] study was carried out on 200 children with IDA (127 males and 73 females) and 50 apparently healthy age and gender-matched controls and showed significant male predominance in H.pylori positive IDA patients.

This came in agreement with the study done **by Zamani *et al.*** [12]**,** who reported that H. pylori infection was significantly more common in boys than girls ($p = 0.029$).

In the current study, we found that there were significant differences between the two groups as regard complaint as in cases mainly complain from easy fatigability, pallor, recurrent abdominal pain, poor appetite, and poor concentration.

In children, it was proposed that H. pylori infection is associated with gastrointestinal disorders as recurrent abdominal pain, dyspepsia, chronic gastritis, and peptic ulcers [13].

Moreover, it was reported that H. pylori may be also associated with several extra-gastrointestinal diseases such as idiopathic thrombocytopenic purpura, anemia, and some allergic diseases [14].

In the current study, we found that there was a significant decrease in weight and BMI among cases group p-value <0.001.

Another study by **Choe *et al.*** [15] showed that Significant differences in height and weight were found between those children with and without iron deficiency anemia ($p = 0.006$ and 0.007, respectively) and thus agree with our result.

In the current study, we found that there was a significant decrease in all CBC parameters among cases versus control.

In consistence with our results, **Demerdash *et al.*** [16] found a significant difference in MCV between H. pylori-positive and H.pylori-negative groups.

Also, an Egyptian study conducted in 60 children found that the soluble transferrin receptor in serum was significantly higher in the H. pylori-positive group compared to the H. pylori-negative group although no significant differences were noted in hematologic variables and iron parameters between the two groups [17].

Abou-Taleb *et al.* [11] showed that hematological parameters (Hb, MCV & HCT) and serum ferritin were significantly lower in H.pylori-positive IDA patients than H.pylori-negative IDA cases.

This variability in studies could be due to differences in the geographical and ethnic distribution of patients, age, inclusion criteria, sample size, sampling procedures, methods of detecting anemia, and methods of detecting H.pylori infection.

In the current study we found that there were significant differences between the two groups regarding nutritional status as in cases there was a higher percentage of low iron sources in the diet, there was a significant decrease in serum iron, ferritin, and TIBC in cases versus control.

On contrary, **Buerkli *et al.*** [18] findings suggest that asymptomatic H. pylori infection in preschool children and young women does not have a significant effect on fractional iron absorption from iron compounds commonly used as food additives.

Two previous studies assessed iron absorption in humans with H. pylori infection using iron isotope techniques, and have produced equivocal results [19, 20], this study is consistent with the previous study in Bangladeshi children [19].

In 2–5-year-old children (thirteen with H. pylori infection and twelve uninfected) with IDA, iron absorption from ferrous sulfate and ferrous fumarate from infant cereal was measured before and after a 14-day course of eradication treatment. There was no significant difference in iron absorption comparing H. pylori non-infected to H.pylori-infected children before treatment and eradication therapy did not affect iron absorption from ferrous sulfate or ferrous fumarate [19].

The authors concluded that although gastric acid output was impaired in H. pylori-infected children and that treatment of H. pylori infection improved gastric acid output, it did not significantly influence iron absorption.

However, in agreement with our result the study by **Romana *et al.*** [20] in which the effect of H. pylori infection (assessed using the urea breath test) on iron absorption was compared in iron-sufficient asymptomatic adults, 24 who were H. pylori-positive and 26 who were H. pylori-negative. They consumed wheat flour-based test meals fortified with radiolabeled ferrous sulfate or ferrous fumarate.

The H. pylori-negative subjects absorbed significantly more iron from ferrous sulfate (10.5% vs. 4.4%) and ferrous fumarate (0.6% vs. 0.4%). Iron absorption was not significantly different between groups after they received a proton pump inhibitor. Compared to the women in this study, the adults in that study had better iron status (mean serum ferritin, ≈45μg/L versus 30μg/L in this study) and received a much larger iron dose (55mg) given with the test meal, compared to the smaller dosages provided in the test meals in this study (3–6mg). Further, the diagnosis of H. pylori infection was made with different methods [20].

In a study by **Ciacci *et al.*** [21] in adults (*n*=55) who were H.pylori-positive or negative,

serum iron levels were measured before and 2 hours after oral supplementation of 1 mg ferrous iron per kg body weight. H.pylori-positive subjects were then administered antibiotic therapy, and the oral iron absorption test was repeated.

They reported that H.pylori-positive subjects before treatment had a smaller increase in serum iron compared to H.pylori-negative subjects, and after H. pylori eradication in the H.pylori-positive subjects, their serum iron increase was similar to those of non-infected subjects, suggesting that H. pylori infection impairs oral iron uptake [(21)].

Sarker *et al.* [(19)] randomized H.pylori-infected children 2–5 years of age with IDA to receive 2-week anti-H. pylori therapy plus 90-day oral ferrous sulfate, 2-week anti-H. pylori therapy alone, 90-day oral iron alone, or placebo; non-infected children with IDA received iron treatment as a negative control. H. pylori infection did not inhibit the response to iron, suggesting it is not a cause of iron deficiency or a reason for treatment failure of iron supplementation in this setting.

However, other studies have suggested that H.pylori-infected children show a blunted response to oral iron [(22)].

A recent systematic review reported that, in observational studies, compared to uninfected persons, H.pylori-infected individuals are at greater risk for iron deficiency and iron-deficiency anemia. Also, prospective trials comparing H. pylori eradication therapy plus iron supplementation, as compared with iron supplementation alone, showed greater increases in serum ferritin with combined therapy [(23)].

Several mechanisms have been suggested as a potential cause of the iron deficiency and/or low iron absorption during H. pylori infection. Chronic gastritis, due to H. pylori, can alter the physiology of the stomach by reducing gastric acid secretion and gastric ascorbic acid levels. Both of which are essential for the absorption of dietary iron [(7)].

H.pylori requires iron for its growth, it expresses proteins associated with iron metabolism [(24)], and it is suggested that it may disrupt host hepcidin regulation [(25)].

A decrease in serum hepcidin levels has been reported after *an* H. pylori eradication therapy, in two studies, however, one of them concluded that the decrease is more related to anemia status than to H. pylori infection as a decrease of hepcidin was also reported in the group receiving iron supplement only without H. pylori eradication therapy [(26)].

Finally, iron losses may increase due to occult bleeding from H. pylori gastritis [(25)].

In the current study, we found that there was a significant increase in the number of positive samples for H pylori antigen in stool among cases versus control 63.3% versus 23.3% p-value 0.002.

This goes with **Abou-Taleb *et al.* [(11)]** as investigations for H. pylori infection revealed that 72 cases (36%) of IDA patients and 6 cases (12%) of non-anemic controls had positive antibody level for H. pylori specific IgG and the difference between the two groups was statistically significant (P = 0.036).

In addition to Choe ***et al.* [(15)]** showed that the prevalence rate of H.pylori infection was 15.5% (53 of 343) in children without iron deficiency anemia and 31.3% (10 of 32) in those affected (p=0.022).

CONCLUSION

The results of this study demonstrate a significant association between children with iron deficiency anemia and positive H. pylori infection in school-age children. Moreover, H.pylori infection may be one of the significant causes of iron deficiency anemia.

REFERENCES

1. **Muhsen K, Barak M, Shifnaidel L *et al.* (2009):** Helicobacter pylori infection is associated with low serum ferritin levels in Israeli Arab children: A seroepidemiologic study. J Pediatr Gastroenterol Nutr., 49:262-4.
2. **WHO/UNICEF/UNU (2001):** Iron deficiency anemia assessment, prevention, and control. Geneva: World Health Organization. https://www.who.int/nutrition/ publications/ micronutrients/anaemia_iron_deficiency/WHO_NHD _01.3/en/
3. **Sarker S, Mahmud H, Davidsson L *et al.* (2008):** Causal relationship of Helicobacter pylori with iron-deficiency anemia or failure of iron supplementation in children. Gastroenterology, 135:1534–1542.
4. **Huang X, Qu X, Yan W *et al.* (2010):** Iron deficiency anemia can be improved after eradication of Helicobacter pylori. Postgraduate Medical Journal, 86(1015): 272-278.
5. **Lutter CK (2008):** Iron deficiency in young children in low-income countries and new approaches for its prevention. The Journal of Nutrition, 138(12): 2523-2528.
6. **Cardenas V, Prieto-Jimenez C, Mulla Z *et al.* (2011):** Helicobacter pylori eradication and change in markers of iron stores among non–iron-deficient children in El Paso, Texas: an etiologic intervention study. Journal of Pediatric Gastroenterology and Nutrition, 52(3): 326-332.
7. **Queiroz D, Harris P, Sanderson I *et al.* (2013):** Iron status and Helicobacter pylori infection in symptomatic children: An international multi-centered study. PLoS One, 8: e68833.
8. **Meroj A Jasem, Al-Ubaidi A, Daood N *et al.* (2011):** Iron deficiency in Helicobacter pylori-infected patients in Baghdad Journal of Microbiology and Infectious Diseases, 1(3):114-17.
9. **Gambino R, Desvarieux E, Orth M *et al.* (1997):** The relationship between chemically measured total iron-binding capacity concentrations and immunologically measured transferrin concentrations in human serum. Clin Chem., 43:2408-2412.

10. **Elwyn G, Taubert M, Davies S *et al.* (2007):** Which test is best for Helicobacter Pylori? A cost-effectiveness model using decision analysis. British Journal of General Practice, 57(538):401-3.
11. **Abou-Taleb A, Allam A, Elsamman M (2017):** Association between Helicobacter pylori Infection and Iron Deficiency Anemia among School-Age Children in Sohag University Hospital, Upper Egypt. Open Journal of Blood Diseases, 7: 36-46.
12. **Zamani A, Shariat M, Oloomi Yazdi Z *et al.* (2011):** Relationship between Helicobacter pylori Infection and Serum Ferritin Level in Primary School Children in Tehran-Iran. Acta Medica Iranica., 49: 314–318.
13. **Suerbaum S, Michetti P (2002):** Helicobacter pylori Infection. New England Journal of Medicine, 347: 1175-1186.
14. **Tan H, Goh K (2012):** Extra gastrointestinal Manifestations of Helicobacter Pylori Infection: Facts or Myth? A Critical Review. Journal of Digestive Diseases, 13: 342-349.
15. **Choe Y, Kim S, Hong Y (2000):** Helicobacter pylori infection with iron deficiency anemia and subnormal growth at puberty. Arch Dis Child, 82:136–140.
16. **Demerdash D, Ibrahim H, Hassan D *et al.* (2018):** Helicobacter pylori-associated to unexplained or refractory iron deficiency anemia: an Egyptian single-center experience. Hematol Transfus Cell Ther., 40(3):219–225.
17. **El-Aziz Awad M, Amin S, Abdou S (2014):** Assessment of diagnostic and therapeutic approaches of Helicobacter pylori-associated iron deficiency and anemia in children with dyspeptic symptoms. J Egypt Soc Parasitol., 44(3):695–708.
18. **Buerkli S, Fatou Ndiaye N, Cercamondi C *et al.* (2019):** Asymptomatic Helicobacter Pylori Infection in Preschool Children and Young Women Does Not Predict Iron Bioavailability from Iron-Fortified Foods. Nutrients, 11(9):2093-95.
19. **Sarker S, Davidsson L, Mahmud H *et al.* (2004):** Helicobacter pylori infection, iron absorption, and gastric acid secretion in Bangladeshi children. Am J Clin Nutr., 80:149–153.
20. **Romana D, Pizarro F, Diazgranados D *et al.* (2011):** Effect of Helicobacter pylori infection on iron absorption in asymptomatic adults consuming wheat flour fortified with iron and zinc. Biol. Trace Elem. Res., 144:1318–1326.
21. **Ciacci C, Sabbatini F, Cavallaro R *et al.* (2004):** Helicobacter pylori impairs iron absorption in infected individuals. Dig. Liver Dis., 36:455–460.
22. **Duque X, Moran S, Mera R *et al.* (2010):** Effect of eradication of Helicobacter pylori and iron supplementation on the iron status of children with iron deficiency. Arch. Med. Res., 41:38–45.
23. **Hudak L, Jaraisy A, Haj S *et al.* (2017):** An updated systematic review and meta-analysis on the association between Helicobacter pylori infection and iron deficiency anemia. Helicobacter, 22:12330-3.
24. **Van Vliet A, Stoof J, Vlasblom R *et al.* (2002):** The role of the Ferric Uptake Regulator (Fur) in the regulation of Helicobacter pylori iron uptake. Helicobacter, 7:237–244.
25. **Beutler E (2007):** Hepcidin mimetics from microorganisms? A possible explanation for the effect of Helicobacter pylori on iron homeostasis. Blood Cells Mol Dis., 38:54–55.
26. **Sapmaz F, Basyigit S, Kalkan I *et al.* (2016):** The impact of Helicobacter pylori eradication on serum hepcidin-25 level and iron parameters in patients with iron deficiency anemia. Wien Klin Wochenschr, 128:335–340.